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CONTRIBUTIONS FROM THE HARVARD MINERALOGICAL MUSEUM.

I. *OCCURRENCE OF NATIVE COPPER AT FRANKLIN FURNACE, NEW JERSEY.*

II. *EXHIBITION AND PRELIMINARY ACCOUNT OF A COLLECTION OF MICROPHOTOGRAPHS OF SNOW CRYSTALS, MADE BY W. A. BENTLEY.*

By J. E. Wolff.

COMMUNICATIONS FROM THE HARVARD MINERALOGICAL MUSEUM.

OCCURRENCE OF NATIVE COPPER AT FRANKLIN FURNACE, NEW JERSEY.

By J. E. Wolff.

Presented April 13, 1898.

In 1897 a large specimen of ore containing native copper from the new (Parker) shaft at North Mine Hill, Franklin Furnace, was acquired for the Harvard Mineralogical Museum.

The specimen, some seven inches square, is broken flat parallel to the banding of the ore body, and is composed of a central band of apple-green willemite interbanded with coarse white calcite and smaller masses of franklinite and zincite in the usual association. The cleavage surfaces of the calcite masses are curved by pressure, and show the development of the gliding planes parallel to $-\frac{1}{2}$ R. In the central zone of the specimen these evidences of pressure become intensified, and small slickensided surfaces are developed in the willemite and calcite, while the former mineral is irregularly cracked in addition to the development of the imperfect cleavage. In this zone native copper occurs, forming a band half an inch wide running parallel to the banding of the ore. The copper has no distinct crystalline form, but occurs as thin films or thicker sheets filling the cracks in the willemite and occasionally in the calcite. Except for traces of oxidation on its surface, the copper is pure and associated with no other mineral.

Of two other specimens loaned by Mr. J. A. Van Mater, superintendent at North Mine Hill, one has the same association described above, and shows a veinlet of copper penetrating calcite along a gliding plane, in addition to the penetration along fissures in the willemite. In the other the copper occurs in willemite which is associated with yellow garnet, black biotite, and calcite. The masses of copper are thicker here, and a projecting point laid bare by the removal of the matrix has some resemblance to a spear-head twin of copper, but is probably a matrix mould.

In May, 1898, small sheets of native copper were seen by the writer in vein matter coming up from the deep levels, but have not yet been observed in the standing vein. The matrix is a light yellow densely granular mineral with resinous lustre, which appears from preliminary tests to be a phase of the yellow manganese garnet (polyadelphite) so common in the vein matter of the Parker shaft. It is intimately mixed in microscopic veinlets and larger masses with an amorphous (often earthy) light pink manganese mineral not further identified. A thin section of this gangue shows cloudy yellow spots of the garnet surrounded by paler transparent material which has the feeble double refraction in sectors of some garnet, a property which has not been observed by the writer in the ordinary deep yellow garnet of the ore body. This abnormal character and the veining by the pink material suggest an alteration of the original garnet gangue with which the deposition of the copper might have been contemporaneous.

Mr. Van Mater states that native copper occurred in 1897 about eight hundred feet below the surface in a seam in the middle of the ore body, i. e. about half way between the hanging and foot walls. This seam was filled with a gangue of rhodonite and other minerals in an earthy porous condition, and probably represents the form just described.

The other occurrence in massive willemite was not observed in the standing vein, but was picked out from the ore coming from about the same depth.

It is evident, from the relations of the veinlets of the copper to the cleavage and cracking of the willemite and secondary pressure planes of the calcite, that its deposition took place *after* the formation of the zinc ores and associated minerals, and that possibly the circulation of the solutions from which it was deposited took place along the same motion planes in the ore body which produced the beautiful slickensides found occasionally in this part of the deposit. There are no facts on which to base a conclusion as to the form in which the copper was carried in solution, nor as to the method of its final reduction and deposition, although it is probable the changes noticed above in the garnet gangue were connected with it.

This occurrence increases the long list of minerals found at Franklin Furnace and vicinity (now nearly seventy), and is an interesting addition to the occurrences of native copper below the zone of surface oxidation.

EXHIBITION AND PRELIMINARY ACCOUNT OF A COLLECTION OF MICROPHOTOGRAPHS OF SNOW CRYSTALS, MADE BY W. A. BENTLEY.

By J. E. Wolff.

Presented April 13, 1898.

The study of snow crystals dates back to the middle of the sixteenth century, when the first drawings appeared in the book of Olaus Magnus in 1555, and other early authors, including Des Cartes and Keppler, have described and figured these forms. In 1820, William Scoresby published 96 drawings of snow crystals made in the Arctic regions, in 1855 J. Glaisher 150, and in the same year Franke 119.

The first reproduction of microphotographs of snow crystals was in the small monograph of G. Hellmann in 1893 with about 60 examples,* and in the same year G. Nordenskiöld published about the same number. † In 1894 Hellmann published a plate of much larger pictures taken by a Russian photographer. ‡

The present collection has been made by Mr. W. A. Bentley of Nashville, Vermont, during the last twenty years, and includes about 400 of the most interesting examples out of a total of 550 made by him. Through the disinterestedness of Mr. Bentley the collection has been acquired at a nominal cost for the Harvard Mineralogical Museum for study and public exhibition.

Its scientific value is enhanced by his notes, which comprise a number of meteorological observations made by himself at the time many of the

* Schneekrystalle-Beobachtungen und Studien, by Professor G. Hellmann, with eleven cuts and eight heliogravures after the micro-photographs of R. Neuhauss, M. D. Berlin, Rudolph Muckenberger. The historical summary given above is taken from this work.

† Preliminary Communication concerning an Investigation of Snow Crystals. Geol. Foren. i Stockholm. Forh. Bd. 15, pp. 146–158. 1893. English summary in Nature, Vol. XLVIII. pp. 592–594.

‡ Meteorologische Zeitschrift, 1894, p. 281.

sets from individual storms were made, including date, temperature, snow fall, condition of the clouds, direction and force of the wind, and sometimes notes as to the general character of the snow crystals and their changes as the storm progressed.

The magnifications used range from 52 to 31 diameters, and are evidently much higher than those of previous collections. The same general types of crystals noticed by previous observers recur here, such as the star form, star form with solid nucleus, and tabular form, while the columnar form (hexagonal prism and base) is rare, and the hexagonal pyramid is not seen. Variations of skeleton growth of hexagonal plates, comprising the base and prism of the first order, predominate; less commonly the intermediate axes are visible by lines of growth or air inclusions, and rarely a triangular development suggests rhombohedral symmetry. The presence of the varied markings due to inclusions of air is much more prominent in these than any as yet published, owing to the higher magnification and the superb technique of the photographs. Mr. Bentley also confirms the previous observation, that large stellate crystals are more common at the higher temperatures and the tabular ones at the lower.

Some photographs of frost crystallizations are included.

Reserving for a future communication the result of more detailed study, a preliminary account is here given of this large and perfect collection which may justly be called a monument to the patience, skill, and enthusiasm of the maker.*

* In "A Study of Snow Crystals," recently published in Appleton's Popular Science Monthly, (May, 1898, pp. 75–82,) by W. A. Bentley and G. H. Perkins, the authors give some account of this collection, with a reproduction of 27 examples.